Decadal Predictability and Prediction in Ocean Eddy Resolving Coupled Models

Ben Kirtman, Leo Siqueira, Lucas Laurindo: University of Miami

Kathy Pegion:George Mason University

Robert Burgman: Florida International University

Di Lorenzo & Joh: Georgia Tech

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S2S (Multi-Year) Predictability and Prediction in Ocean Eddy Resolving Coupled Models

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Multi-Model*: CESM & E3SM

- **Predictability**
  - **Extended Simulations**
  - **Homogeneous (Identical Twin) Experiments**
- **Initialized Prediction**
  - **Brute Force (Operational NOAA Analysis)**
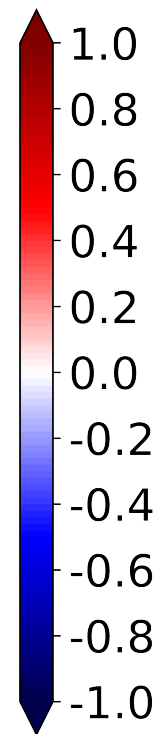 - **Ocean-Only (CORE Forcing) Derived**

*Curse and Blessing

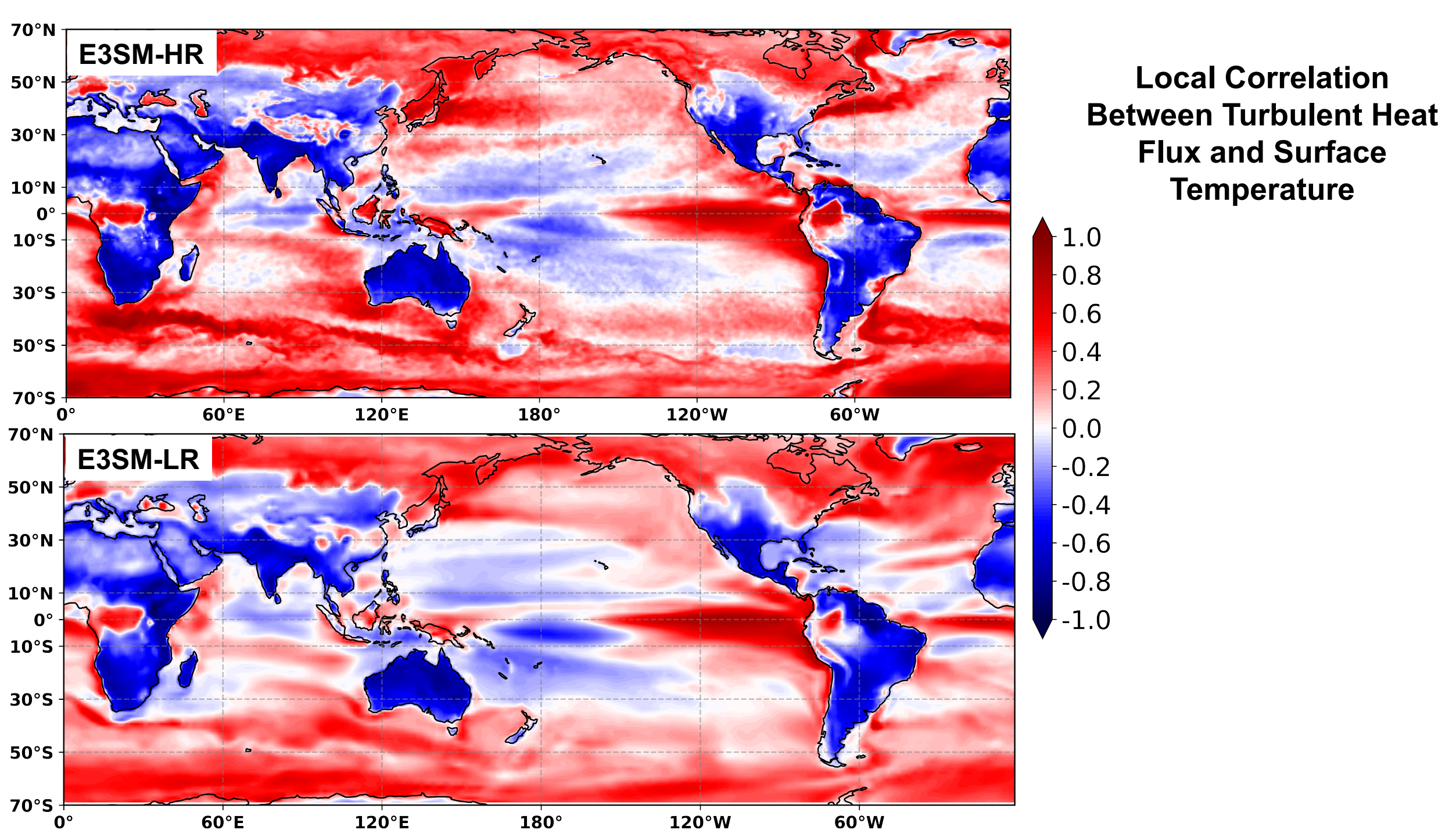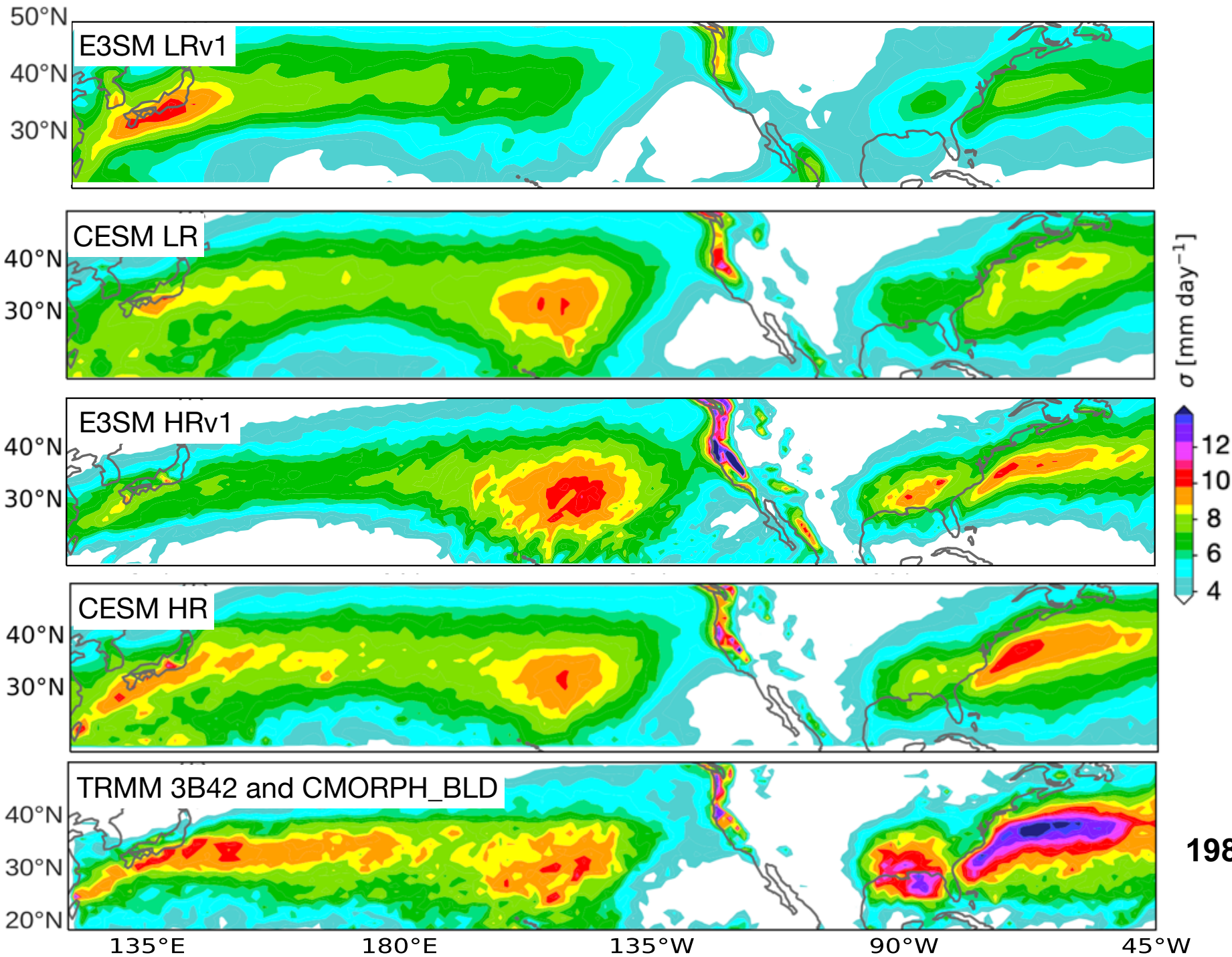|	
CESM-LR (Ocean Eddy Parameterized)	**CESM-HR (Ocean Eddy Resolving)**
E3SM-LR (Ocean Eddy Parameterized)	**E3SM-HR (Ocean Eddy Resolving)**

catalyst
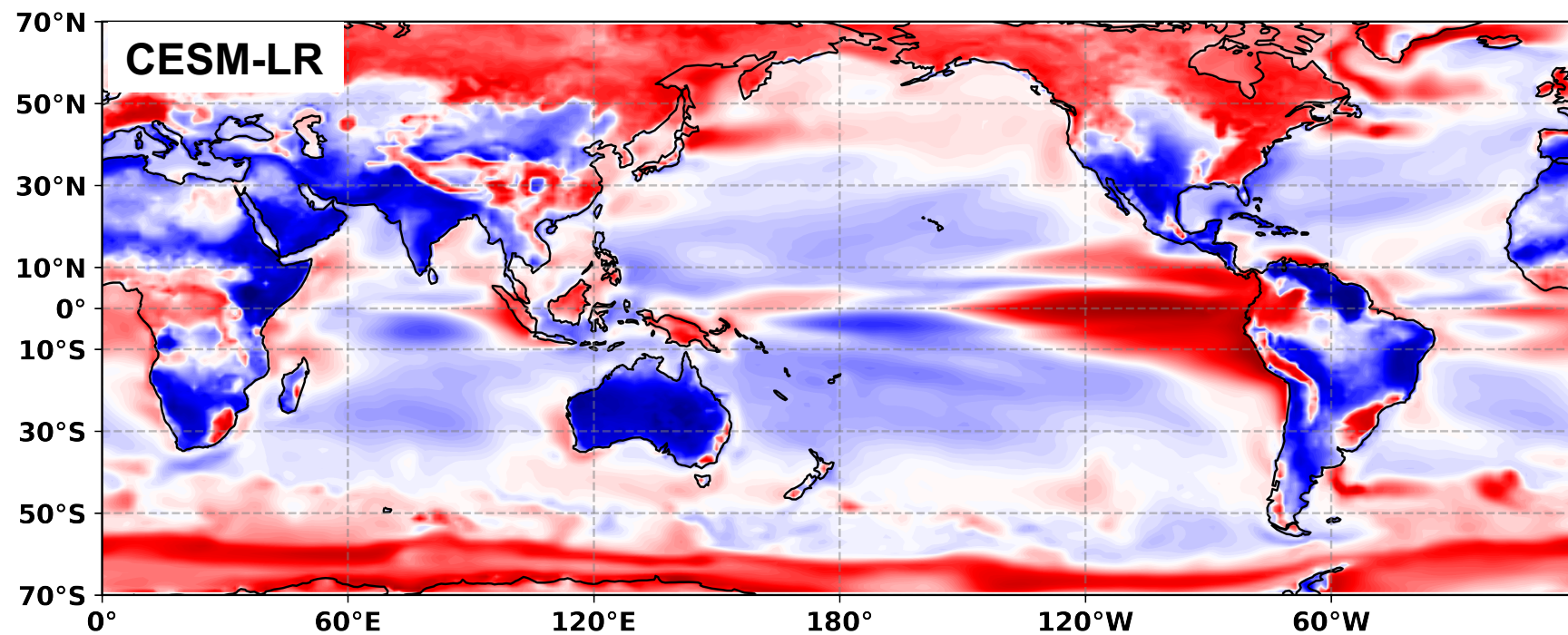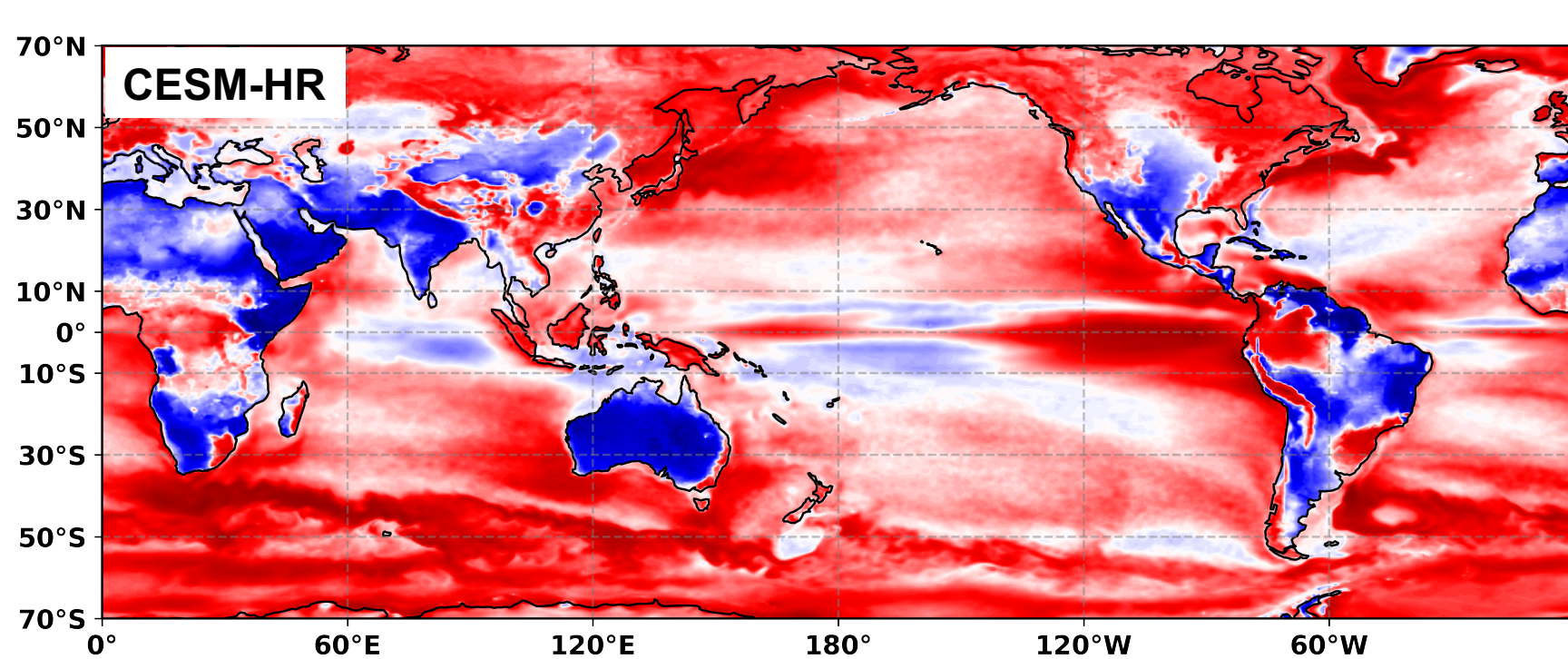
Local Correlation Between Turbulent Heat Flux and Surface Temperature

Kirtman et al., (2012; 2017)

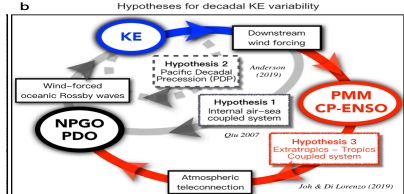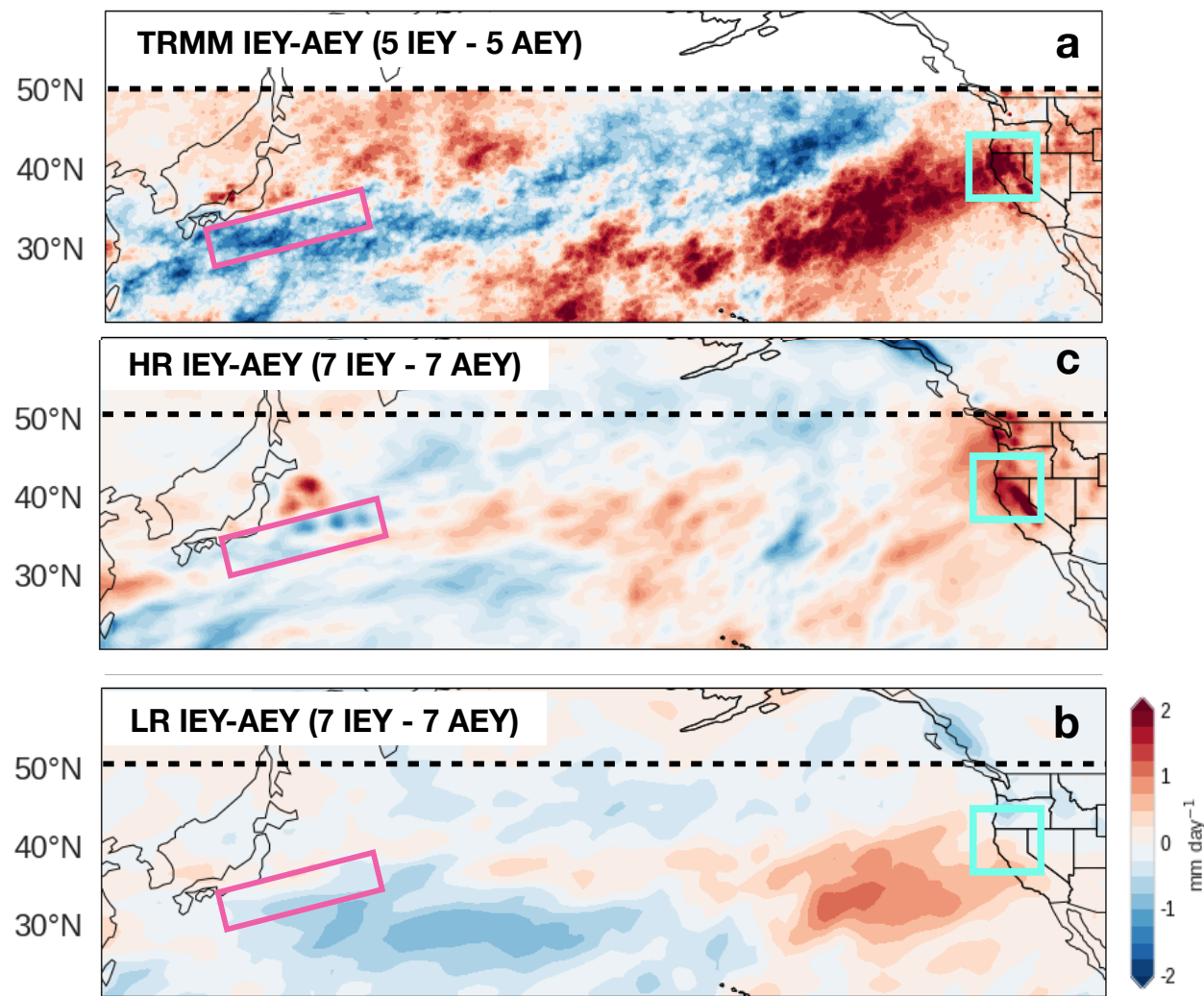Local Correlation Between Turbulent Heat Flux and Surface Temperature

January Through March Daily Rainfall Standard Deviation

E3SM LRv1

CESM LR

E3SM HRv1

CESM HR

TRMM 3B42 and CMORPH BLD

1982-2016

Siqueira et al. (2020)

Western North American Rainfall Forecasts: CESM-HR

LR IEY-AEY (7 IEY - 7 AEY)

HR IEY-AEY (7 IEY - 7 AEY)

Figure 1. Observed and Simulated rainfall changes in response to mesoscale SST forcing (A) Difference of TRMM winter season (NDJFM) mean rainfall (mm d^{-1}) between Inactive Eddy Years (IEYs) and Active Eddy Years (AEYs). (B) TRMM daily rainfall PDF difference between IEYs and AEYs along the Kuroshio
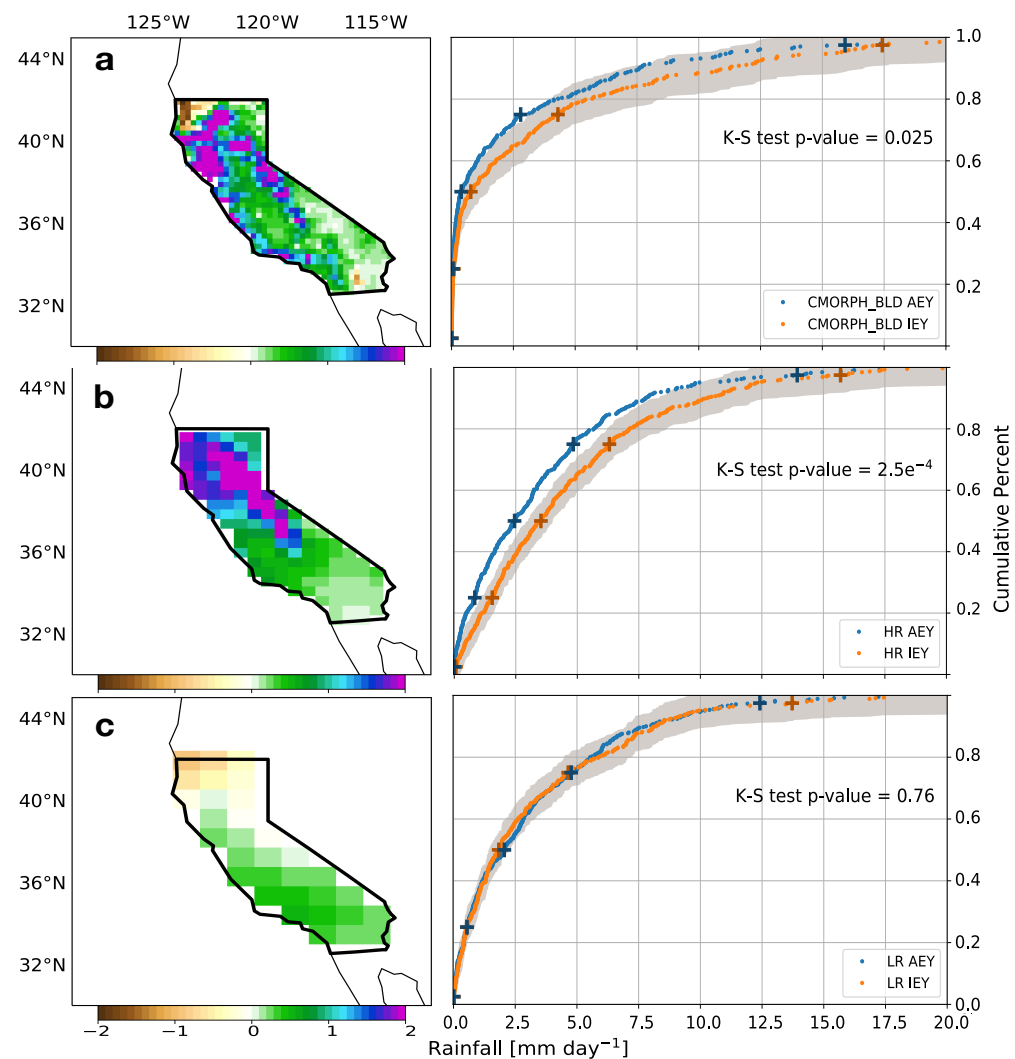
Observational Estimates
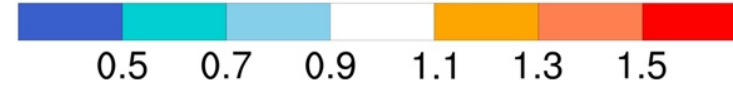
c

Year -2

f

Year +6

Hypotheses for decadal KE variability
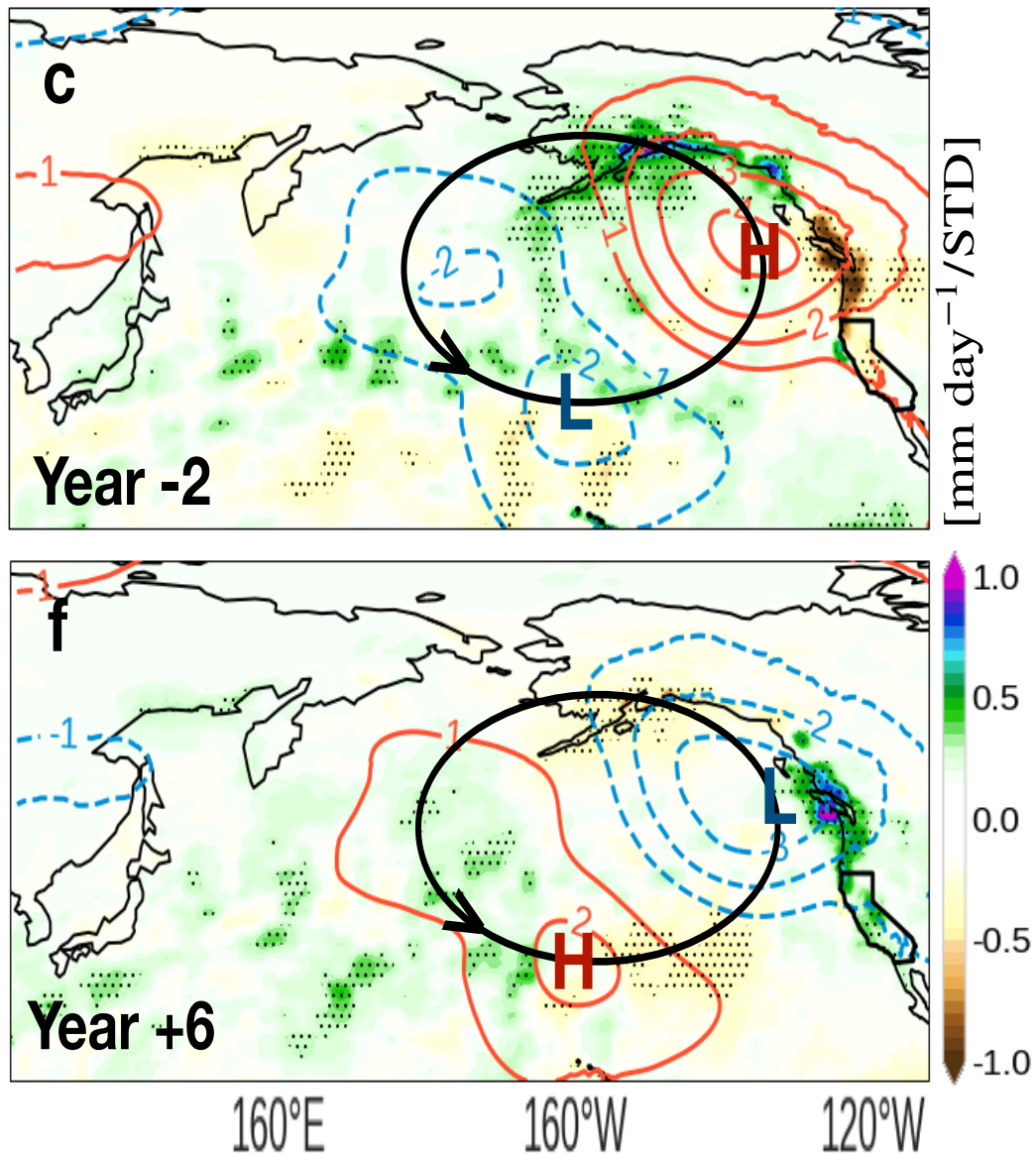
**E3SM-LR Homogeneous Predictability:
10-Member Ensemble**
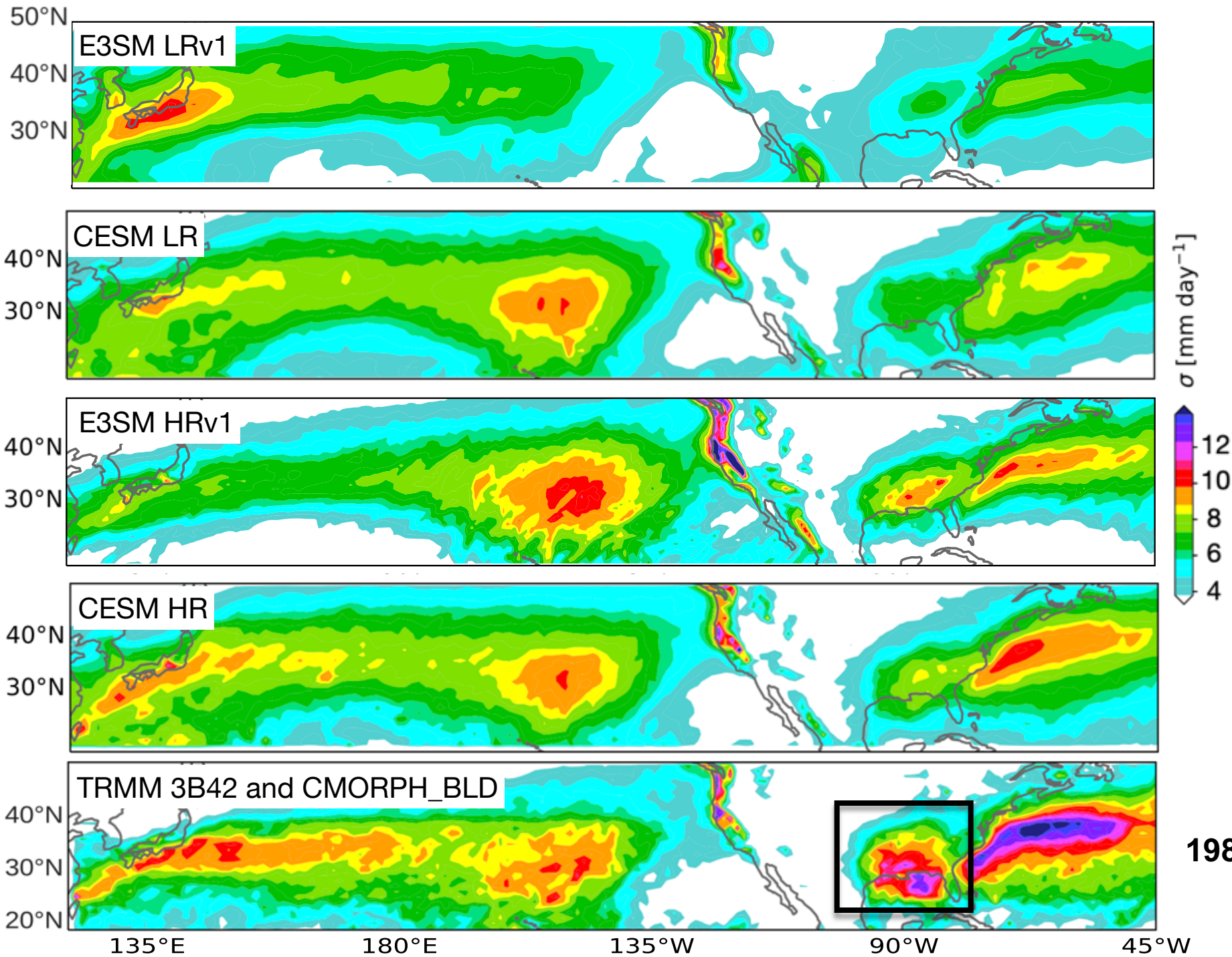
1st JFM

2nd JFM

4th JFM
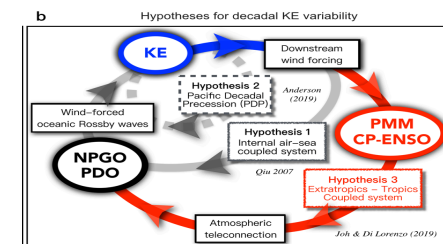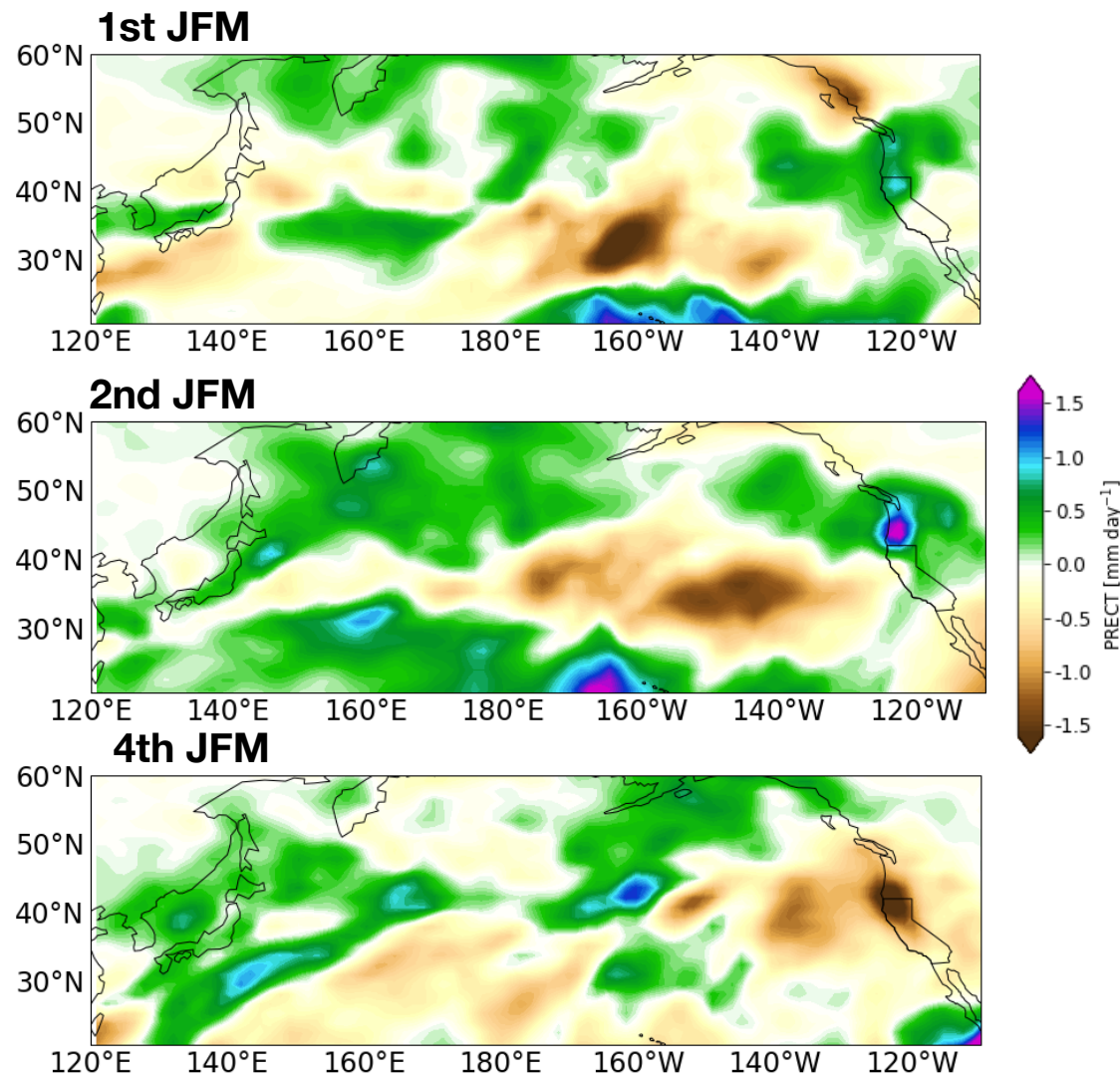
CESM-HR Idealized (Homogeneous) Decadal Predictability Experiments
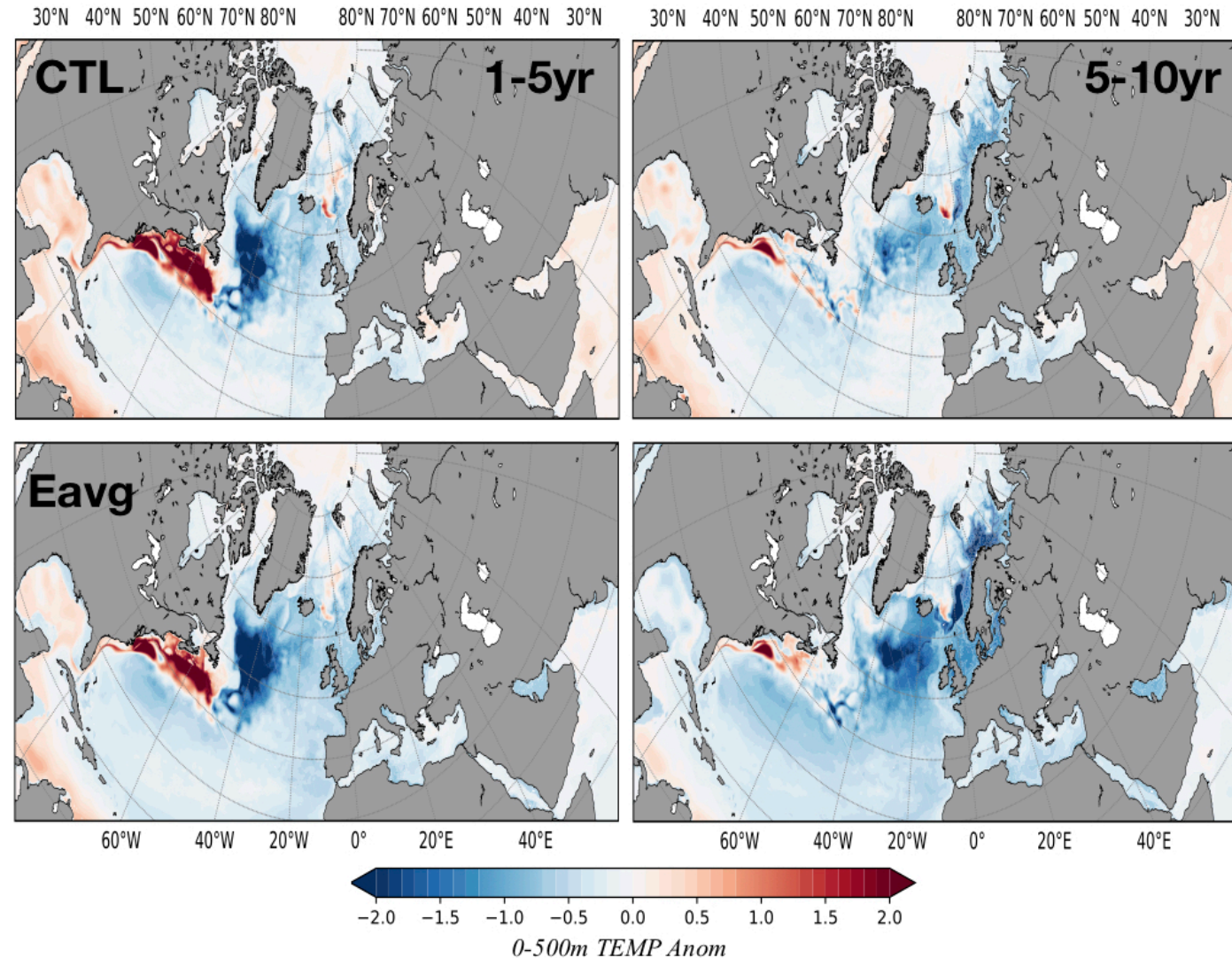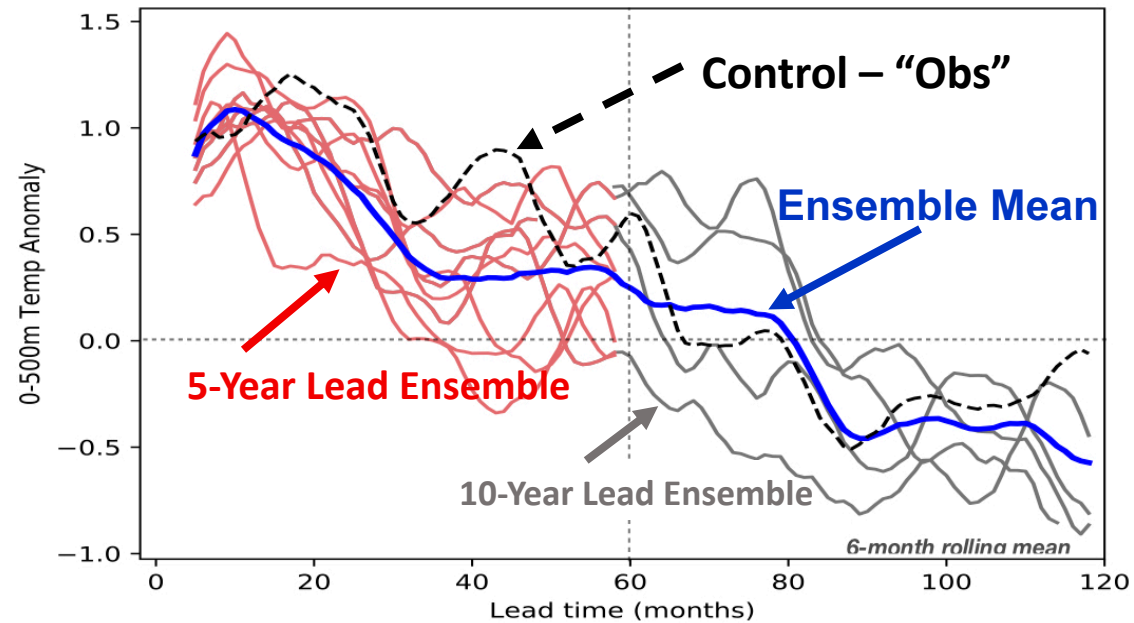
CESM-HR Model Based Estimates of Multi-Year (Decadal) Predictability

(a) HR
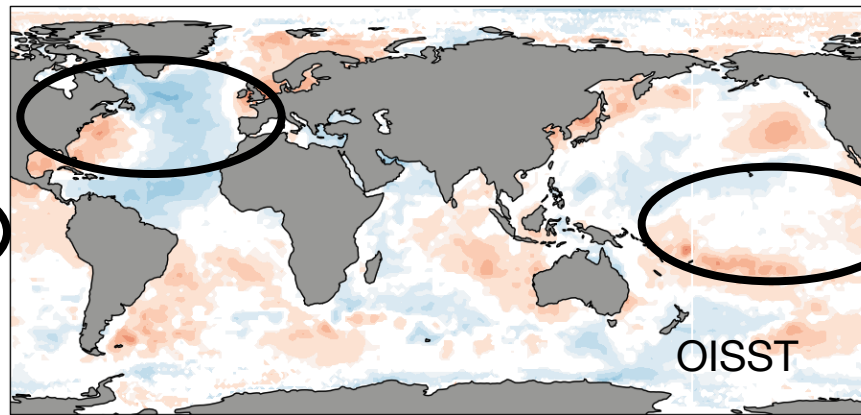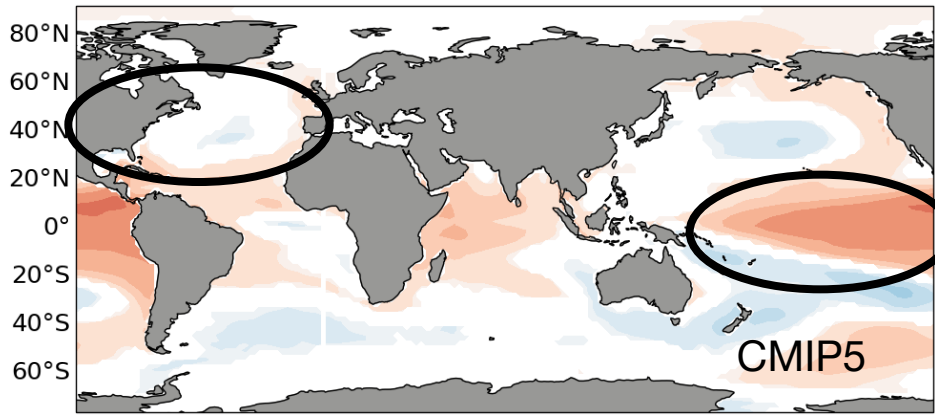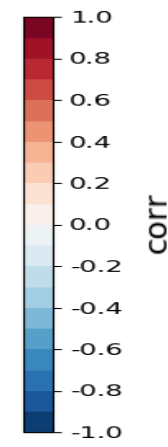
$(\sigma^2_{Lf}/\sigma^2_{Tot} \times 100\%)$

Percent

(b) HR/LR

$(\sigma^2_{Lf}/\sigma^2_{Tot} \times 100\%)$

(c) HR

Correlation (SST, T$_{300-700m}$)

(d) HR

Correlation (SST, T$_{300-700m}$)

Zhang et al (2020, Climate Dynamics)

E3SM LRv1

CESM LR

E3SM HRv1

CESM HR

TRMM 3B42 and CMORPH_BLD

January Through March Daily Rainfall Standard Deviation

σ [mm day^{-1}]
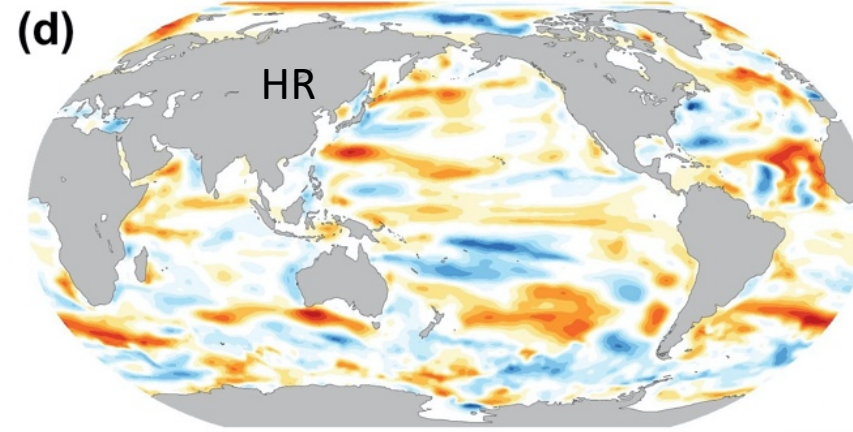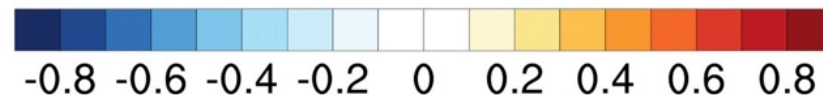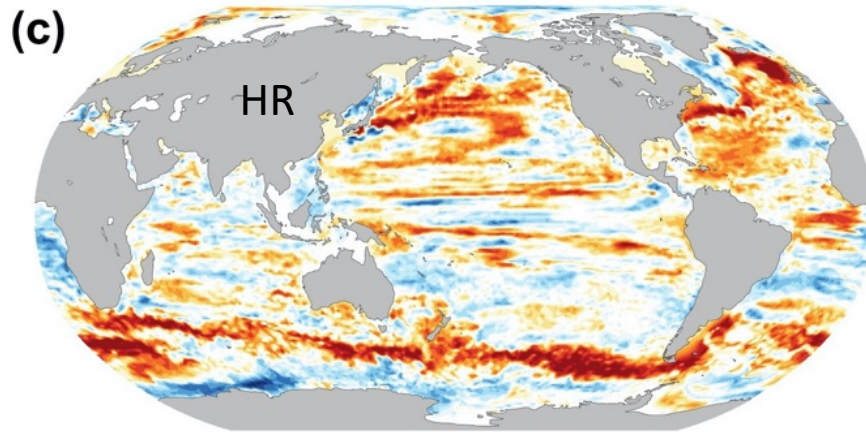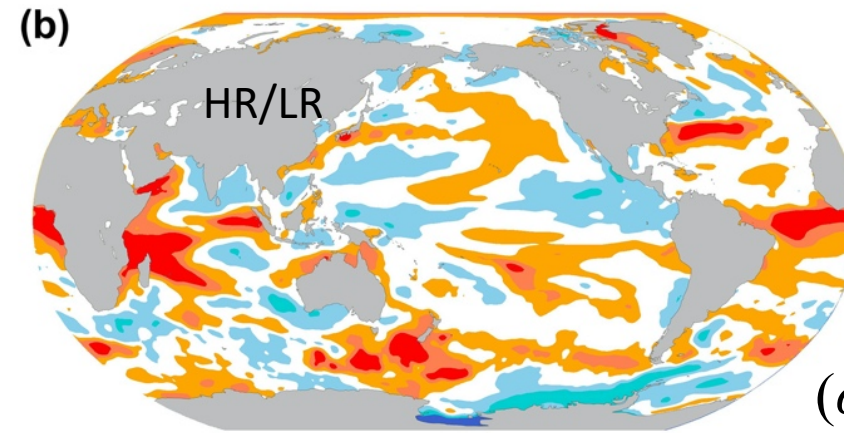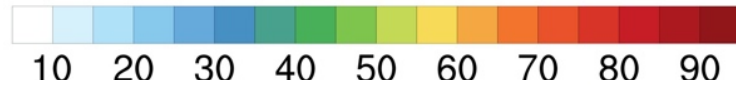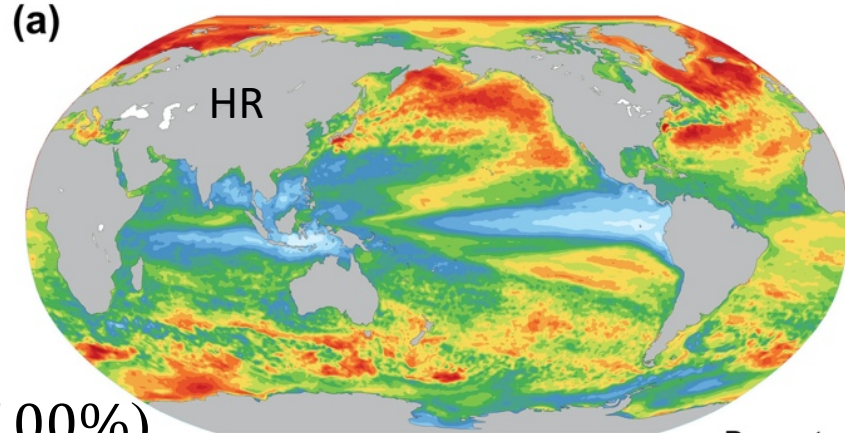
1982-2016

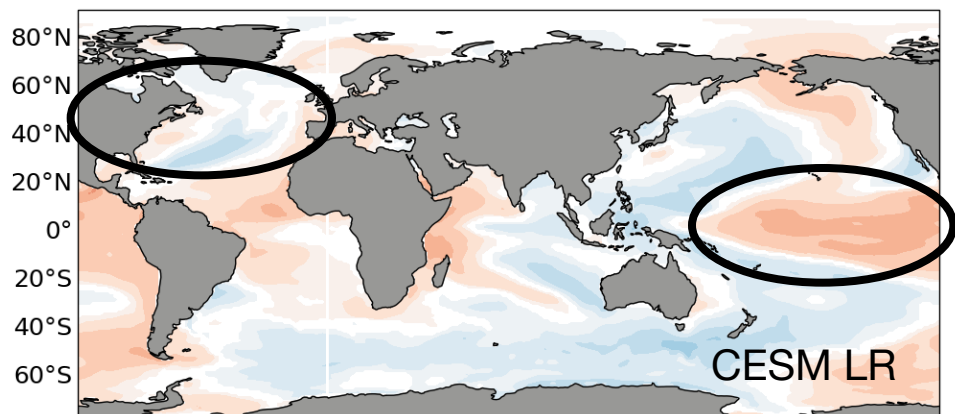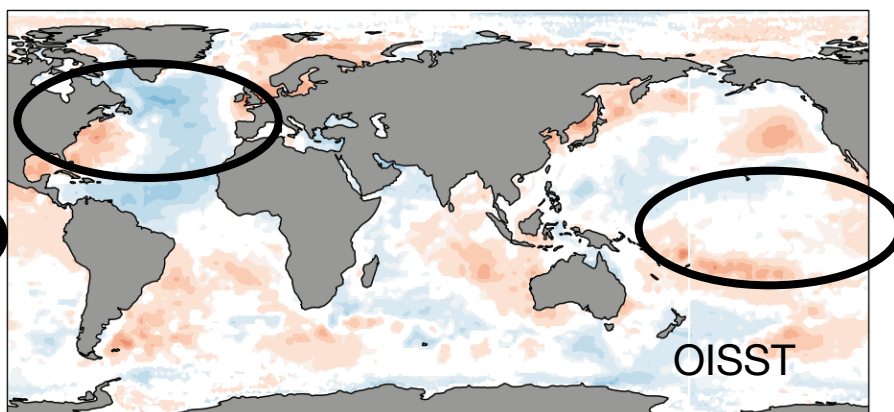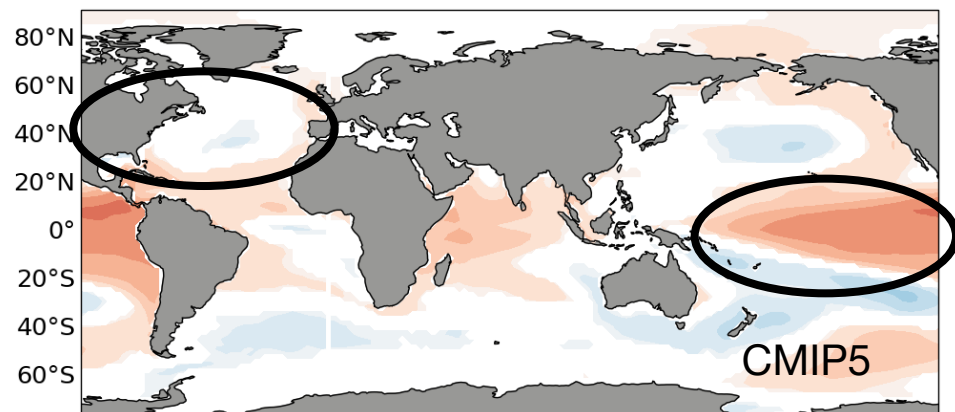Siqueira et al. (2020)

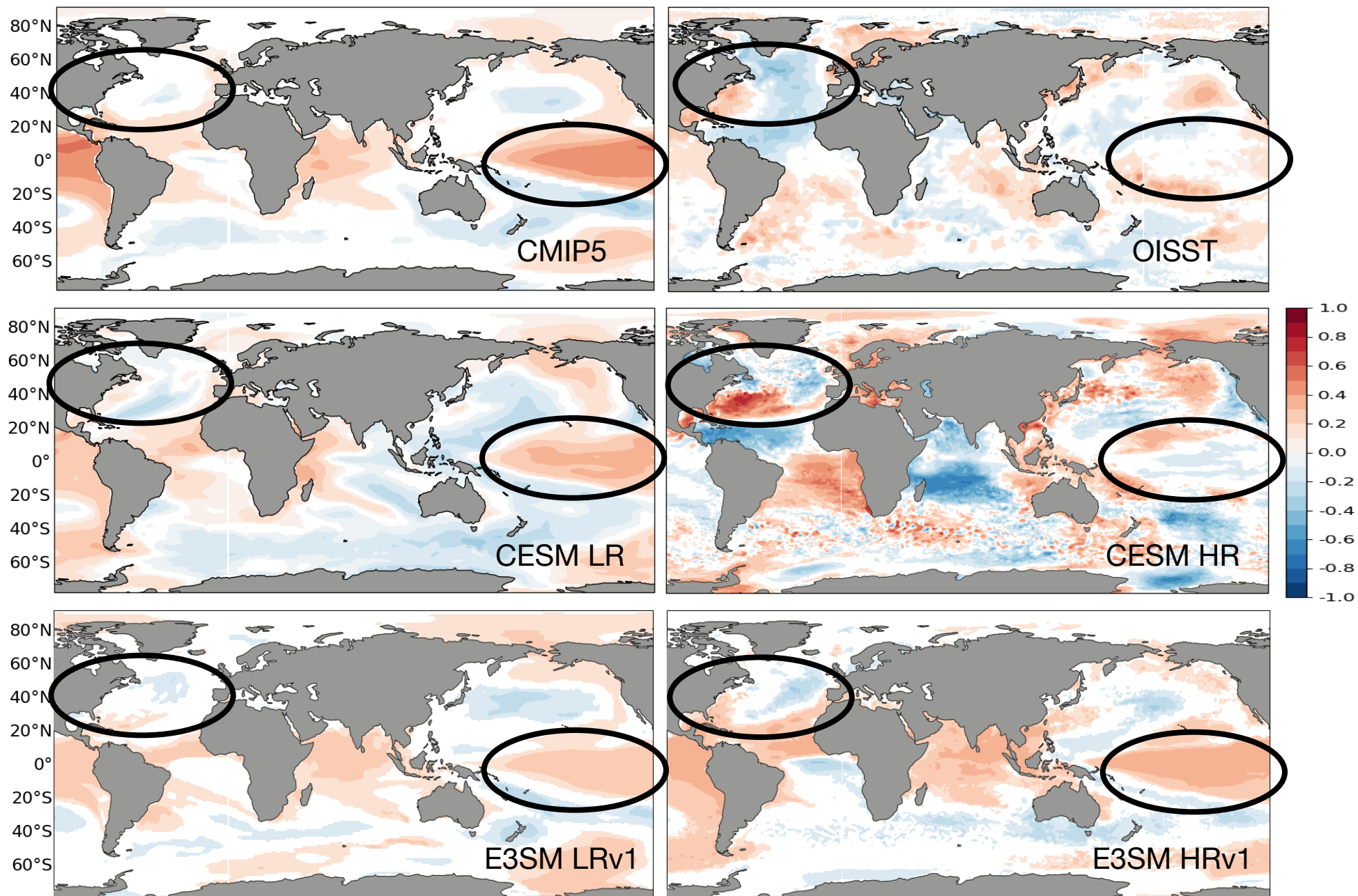**Teleconnection Low Frequency SEUS Rainfall and Global SST**

econnection Low
requency SEUS
fall and Global SST

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